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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/027,462	12/21/2001	Leonid Yaroslavsky	10010525-1	1553

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EXAMINER	
SETH, MANAV	

ART UNIT	PAPER NUMBER
2625	

DATE MAILED: 10/31/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/027,462	YAROSLAVSKY ET AL.	
	Examiner	Art Unit	
	Manav Seth	2625	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *08 August 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-12,14 and 21-35* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *15-20* is/are allowed.

6)☒ Claim(s) *1-12,21-28 and 30-35* is/are rejected.

7)☒ Claim(s) *14, 29* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Response to Amendment

1. The amendment received on August 08, 2005 has been entered in full.

2. Applicant's amendment to the claims has been entered and based on the amendments claim, 35 USC 112 1st paragraph rejections on the respective claims have been withdrawn.

Response to Arguments

3. Applicant's arguments regarding the prior art rejections under Zwirn, Onoguchi and Rooks on pages 14-18 of the amendment filed on August 08, 2005, have been fully considered but are not persuasive.

4. In the 3rd paragraph of the page 14 of 18, Applicant argues in substance:

a. **The examiner "chose only edge density to determine an optimum focus position to reject the claim 1". Applicant has amended claim 1 effectively removing the "only edge density" alternative, thereby rendering the Examiner's choice moot. Moreover, Zwirn et al., fail to disclose using either a comparison between an image of a typical object and image of the object created by the imaging system or an edge density in an image of the object and the comparison to determine an optimum focus position" as recited in claim 1, as amended.**

Examiner respectfully disagrees. In the previous office action mailed on May 13, 2005, examiner considering the broad interpretation of the claim 1 chose "only edge density to determine an optimum focus position", however examiner did not disclose (or agree) that this reference by

Zwirn does not teach "determining an optimum focus position using an edge density in an image of the object and the comparison". Examiner did use the reference Zwirn before to reject claim 3, which involves comparison of images also, in addition to edge density calculation. Therefore, all the arguments by applicant in the amendment filed are moot in view of the rejections made below in view of the amended claims.

Claim Rejections - 35 USC § 102

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

6. Claims 1-3, 5-8, 10-12 and 31-33 are rejected under 35 U.S.C. 102(b) as being anticipated by Zwirn et al., U.S. Patent No. 4,789,898.

Claim 1 recites a method of automatically focusing an imaging system on an object comprising: using either (a) **a comparison between an image of a typical object and the image of the object created by the imaging system,** or (b) **an edge density in an image of the object and the comparison,** to determine an optimum focus position. As the claim 1 recites using one alternative to determine an optimum focus position, examiner chose only **edge density in an image of the object and the comparison** to determine an optimum focus position to reject the claim 1.

In the previous office action mailed on May 13, 2005, examiner considering the broad interpretation of the claim 1 chose "only edge density to determine an optimum focus position", however examiner did not disclose (or agree) that this reference by Zwirn does not teach "determining an optimum focus position using an edge density in an image of the object and the comparison". Examiner did use the reference Zwirn to reject claim 3, which involves comparison of images also, in addition to edge density calculation.

Zwirn discloses "the present invention relates to the field of automatic focusing systems and more particularly to the field of automatic focusing systems driven by **scene information**" (col. 1, lines 5-10), particularly information relating to the high frequency spectral (edge) density of the scene (col. 1, lines 54-58), where it is apparent that a **scene could be an object focused by an imaging system.** Zwirn further discloses determining an optimum focus position by adjusting the focus position towards the focus position where the high frequency content increases thereby increasing the sharpness of the focus (optimum focus) (col. 1, lines 62-65; col. 2, lines 1-10, lines 41-45, col. 3, lines 50-60; col. 4, lines 35-39).

Zwirn further discloses "As the video information gathering device is brought into focus the high frequency content of the video signal will increase. By passing the video signal through a band pass filter and then processing it in a conditional integrator, a control signal is generated whose amplitude contains information relating to the degree of focus. The control signal is stored and later compared to a control signal derived from a subsequent scanning. Once a significant change in control signal levels is detected a drive signal is sent to the focusing device. If after being driven the subsequent scene has less high frequency (edge density) content, the a drive signal in the opposite polarity or direction is sent to the focusing device. In this manner the scene is toggled into focus only when the scene is initially defocused" (col. 1, lines 62-68 through col. 2, lines 1-10). It is clear

from the above disclosure by Zwirn that a control signal which is a measure of edge density (high frequency components) of each scan (or image) of the scene (or object) at each different focus is computed and then according to the focus or scan position that has the greatest edge density (high frequency components) the optimum focus position is determined and thus a set of images (scans) of the scene are evaluated using edge density. The first control signal representing first focus position stored in the memory is compared to the second (subsequent) control signal representing second (subsequent) focus position, to determine the direction of the focusing to obtain optimum (third) focus position. It is clear from the Zwirn's disclosure as disclosed above, that first control signal the first control signal representing first focus position stored in the memory is taken as the reference image (or scan) signal of the scene (typical object), and the second (subsequent) control signal representing second (subsequent) focus position corresponds to an image of the scene (typical object) that closely matches the image of the object.

Since Zwirn does cover the method (b) which recites both an "edge density and image comparison", therefore method using "image comparison" or method "edge density", to compute a optimum focused image, automatically are covered under the same rejection.

Claim 2 recites "the method of claim 1, wherein using an edge density in an image of the object comprises: computing the edge density of each image of a set of images of the object; and using a focus position corresponding to an image of the set having a greatest edge density as the optimum focus position". Zwirn further discloses "As the video information gathering device is brought into focus the high frequency content of the video signal will increase. By passing the video signal through a band pass filter and then processing it in a conditional integrator, a control signal is

generated whose amplitude contains information relating to the degree of focus. The control signal is stored and later compared to a control signal derived from a subsequent scanning. Once a significant change in control signal levels is detected a drive signal is sent to the focusing device. If after being driven the subsequent scene has less high frequency (edge density) content, then a drive signal in the opposite polarity or direction is sent to the focusing device. In this manner the scene is toggled into focus only when the scene is initially defocused" (col. 1, lines 62-68 through col. 2, lines 1-10). It is clear from the above disclosure by Zwirn that a control signal which is a measure of edge density (high frequency components) of each scan (or image) of the scene (or object) at each different focus is computed and then according to the focus or scan position that has the greatest edge density (high frequency components) the optimum focus position is determined and thus a set of images (scans) of the scene are evaluated using edge density.

Claim 3 recites "the method of claim 1, wherein using a comparison between an image of a typical object and an image of the object comprises "applying a difference between a first focus position and a second focus position of the imaging system to a third focus position corresponding to the image of the object, such that the third focus position is adjusted to the optimum focus position, wherein the first focus position corresponds to a reference image of the typical object, and wherein the second focus position corresponds to an image of the typical object that closely matches the image of the object". As discussed in the rejection of claim 2, the first control signal representing first focus position stored in the memory is **compared** to the second (subsequent) control signal representing second (subsequent) focus position, to determine the direction of the focusing to obtain optimum (third) focus position. It is clear from the Zwirn's disclosure as disclosed in the rejection of claim 2, that first control signal the first control signal representing first focus position

stored in the memory is taken as the reference image (or scan) signal of the scene (typical object), and the second (subsequent) control signal representing second (subsequent) focus position corresponds to an image of the scene (typical object) that closely matches the image of the object.

Regarding claim 5, claim 5 has been similarly analyzed and rejected as per claims 1-3. The first focus position is read as the starting focus position. Claim 5 recites the additional limitations "the typical object representing a class of objects, the object being a member of the class". Here examiner asserts that as discussed in rejection of claims 1-3, Zwirn discloses focusing an scene and scene is not limited to represent an object which further apparently belongs to some class, for example, object being an Toyota SUV (sport utility vehicle) represents an SUV class, and Toyota SUV being a member of an SUV class etc.

Claim 6 has been similarly analyzed and rejected as per claims 1-3 and 5.

Claim 7 has been similarly analyzed and rejected as per claims 1-3 and 5.

Claim 8 has been similarly analyzed and rejected as per claims 1-3, 5 and 7.

Claim 10 has been similarly analyzed and rejected as per claims 1-3, 5, 7 and 8.

Claim 11 recites "the method of claim 10, wherein the computed edge density is a relative measure of edges in each of the images". As discussed in the rejection of claims 1 and 2, Zwirn discloses the computed high frequency spectral (edge) density of the scene (object) is measured by

measuring high frequency components (edges) in each of the images. Therefore, claim 11 has been similarly analyzed and rejected as per claims 10, 1-3, 5 and 7-8.

Claim 12 recites "The method of claim 10, wherein the edge density is computed using an edge density metric employing one of any gradient-based and any non-gradient-based edge detection and image processing methods". As discussed in the rejection of claim 2, the video signal is passed through the band pass filter **15** to determine the degree of focus (edge density). Therefore, claim 12 has been similarly analyzed and rejected as per claims 10, 1-3, 5 and 7-8.

Claims 31-33 have been similarly analyzed and rejected as per claims 10, 1-3, 5 and 7-8.

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

8. Claims 4 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zwirn et al., U.S. Patent No. 4,789,898, further in view of Applicant's admitted prior art in the instant invention.

Claim 4 recites "The method of claim 1, wherein using one or both of an edge density and a comparison automatically accounts for warpage in the object". As discussed in the rejection of claim 1and 2, each image or scan has it's own focus position and using the edge density the optimum focus position for the scene (or object) is determined at that part of the scene. However, it would be apparent to the one of ordinary skill in the art that if scene or object is large enough to scan or image at one time, different parts of scene or object may be brought into focus where each part has different edge density at different focus position, and when all different focused parts are looked at all together it would appear like a warpage and this is well known in the art too. Applicant's has admitted in background of the art that "If the PCB is large, several targets may be used at different xy-locations on the board to account for possible warpage of the PCB" (specification, page 2, lines 25-26). Therefore, it would have been obvious for one of ordinary skill in the art at the time of invention was made to view a scene or an object with different focusing targets on the scene or object all together as a warpage.

Claim 9 has been similarly analyzed and rejected as per claim 4.

9. Claims 21-24, 26-28 and 34-35 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zwirn et al., U.S. Patent No. 4,789,898, further in view of Onoguchi et al., U.S. Patent No. 6,067,164.

Claim 21 recites "An imaging system having automatic focusing comprising: an imaging subsystem that images an object; a memory; a computer program stored in the memory; and a controller that executes the computer program and controls the imaging subsystem, wherein the computer program comprises instructions that, when executed by the controller, implement using an

image of the object created by the imaging system to determine an optimum focus position, the determination being either **image comparison-based** or **edge density-based and image-comparison-based**". Zwirn discloses video camera (col. 3, lines 42-45) which captures the object or scene image and sends it to the circuit in figure 1, where figure 1 shows the controller which controls the auto-focusing performed by video camera and Zwirn as discussed in the rejection of claim 2, also uses memory to store the degree of focus (edge density) value which is calculated to determine the optimum focus position. Zwirn does teach automatic focusing using the circuit in figure 1 but Zwirn does not teach the control of automatic focusing using a software stored on a memory but it is very well known in the art that any image processing function controlled using only a hardware, can also be controlled using software and this is further supported by Onoguchi.

Onoguchi performs auto-focusing on electron microscope for semiconductor inspection (col. 3, lines 40-52; col. 20, lines 13-21) and teaches high frequency component determination to find the sharp focus position (col. 24, lines 58-68) and further teaches that the auto-focusing can be controlled using a computer readable program embedded on a computer readable medium (memory) (col. 4, lines 34-41). Therefore, it would have been obvious for one of ordinary skill in the art at the time of invention was made to control the auto-focusing using a computer program as taught by Onoguchi in the invention of Zwirn because both references belong to the same field of automatic focusing of an object and Onoguchi an automatic image auto-focusing using software so that a work load on the operator can be reduced while the throughput of the process can be improved considerably (see Onoguchi: col. 3, lines 50-52). Onoguchi further teaches "the present invention may be conveniently implemented using a conventional general purpose digital computer programmed according to the teachings of the present specification, as will be apparent to those skilled in the computer art. Appropriate software coding can readily be prepared by skilled

programmers based on the teachings of the present disclosure, as will be apparent to those skilled in the software art" (col. 28, lines 49-57). All other limitations recited in claim 21 have been similarly analyzed and rejected as per claims 1-3, 5, 7-8, and 10-12.

Claim 22 has been similarly analyzed and rejected as per claims 21, 1-3, 5, 7-8, and 10-12.

Claim 23 has been similarly analyzed and rejected as per claims 21, 1-3, 5, 7-8, and 10-12.

Claim 24 has been similarly analyzed and rejected as per claims 21, 1-3, 5, 7-8, and 10-12.

Claim 26 has been similarly analyzed and rejected as per claims 21-24, 1-3, 5, 7-8, and 10-12.

Claims 27-28 has been similarly analyzed and rejected as per claims 26, 21-24, 1-3, 5, 7-8, and 10-12.

Claims 34-35 has been similarly analyzed and rejected as per claims 26, 21-24, 1-3, 5, 7-8, and 10-12.

10. Claims 25 and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zwirn et al., U.S. Patent No. 4,789,898, further in view of Onoguchi et al., U.S. Patent No. 6,067,164 and further in view of Rooks et al., IEEE, June 5, 1999, "Development of an inspection process for ball-grid-array technology using scanned-beam x-ray laminography".

Claim 25 recites "the image system of claim 21 being an x-ray laminography system". Zwirn and Onoguchi both does not disclose the image system being an x-ray system, but Onoguchi as discussed in the rejection of claim 21 discloses semiconductor inspection using automatic focusing of microscope and Zwirn as discussed in the rejection of claim 1 teaches "the present invention relates to the field of automatic focusing systems and more particularly to the field of automatic focusing systems driven by **scene information**" (col. 1, lines 5-10). Rooks teaches that in order to inspect the eutectic-solder fillets of BGA joints using an X-ray system, **the system must be able to focus on a particular horizontal cross-sectional plane** and, therefore, isolate the solder fillets from the solder balls and Rooks further teaches Scanned-beam x-ray laminography (SBXLAM) which is the only **automated** solder inspection system which is capable of focusing on a horizontal plane to examine features within the plane with great detail and contrast (page 851, right col., last para. through page 852, left col.). Therefore, it would have been obvious for one of ordinary skill in the art to use the automatic focusing as taught by combined invention of Zwirn and Onoguchi in the X-ray laminography system of Rooks because Zwirn teaches "the present invention relates to the field of automatic focusing systems and more particularly to the field of automatic focusing systems driven by **scene information**" which is also applicable to Rooks, as Rooks wants to isolate the **solder fillets from the solder balls** (scene information) by using system that is able to focus on a particular horizontal cross-sectional plane as discussed before, which is scene driven focusing and Onoguchi discloses semiconductor inspection which is also applicable to Rooks. Further Rooks teaches automated system, from which it is clear the focus is automatically performed by system and further support is provided by Rooks on page 860, right column, first paragraph.

Claim 30 has been similarly analyzed and rejected as per claims 26, 25, 1 and 2.

Allowable Subject Matter

Reasons of Allowance:

11. Claims 15-20 are allowed.

The following is an examiner's statement of reasons of allowance:

The instant invention relates to a method of determining a change in focus position of an imaging system. The invention method comprises comparing the image of the **second object to the images in the set of images of the first object to find a closest matching image**, the closest matching image from the set having an associated third focus position; and determining a change in the second focus position to provide an optimum focus position for imaging **the second object** with the imaging system where the object being representative of a class of objects. These features in combination with the other elements of the claim 15, are not disclosed or suggested by the prior art of record. Claims 16, 17, 18, 19 and 20 are dependent on the allowable claim 15, and thus they are allowable.

12. Claim 14 is objected to as being dependent upon a rejected base claim 10, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is an examiner's statement of reasons of allowance:

The same reason of allowance applied to claim 15 applies to the claim 14.

13. Claim 29 is objected to as being dependent upon a rejected base claim 26 but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is an examiner's statement of reasons of allowance:

The same reason of allowance applied to claim 15 applies to the claim 29.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Manav Seth whose telephone number is (571) 272-7456. The examiner can normally be reached on Monday to Friday from 8:30 am to 5:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Bhavesh Mehta, can be reached on (571) 272-7453. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system,

see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Manav Seth
Art Unit 2625
October 26, 2005

KANJIBHAI PATEL
PRIMARY EXAMINER